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SPACE CREATION DYNAMICS IN BASKETBALL: A COMPARISON BETWEEN BRITISH AND SPANISH LEAGUES

by

Phillip Crum

A Dissertation submitted in partial fulfilment of the
requirements of the University of Chester for the degree of
M.Sc. Sports Sciences (Performance Analysis)

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Abstract

The most important states for the basketball offence are the ones that produce a rupture in the defence; these are referred to as space creation dynamics (SCD). The British League (BBL) currently falls out of the top 20 domestic leagues in Europe. Spanish Liga ACB is currently ranked the highest league outside of North America. The purpose of this study is to compare the SCD classes used between the BBL and the Liga ACB. The SCD classes are Space Creation with Ball Dribbled, Space Creation with Ball not Dribbled, Perimeter Isolation, Post Isolation, Space Creation Without Ball, On Ball Screen and Out of Ball Screen. Each SCD class occurrence was recorded on a location grid. Twelve games from both the BBL and the Liga ACB were analysed. A total of 3793 possessions were analysed. Intra- and inter-rater reliability was performed using the Cooper et al (2007) method. The results identified several differences between the SCD classes used between the BBL and Liga ACB; Space Created ball Dribbled, On the ball Screen and Off the Ball Screen in the percentage of usage between the BBL and the Liga ACB. A statistical difference was found between the two leagues. BBL used 31.6% on space created with ball dribbled compared to Liga ACB 18.5%. Liga ACB used 19.5% of possessions using on the ball screen compared to BBL 7.5%. Liga ACB used 11.8% with out of ball screen compared to BBLs 5.4%. The practical implications of this study should be primarily aimed at the coaches and then secondly aimed at the players. Developing the BBL to use multiple solutions to create a rupture in the defence would lead to a more developed league which could mimic the tactical play of the Liga ACB.

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Introduction

Basketball is a complex team sport in which the basic aim is to score more points than the opposing side through constant alternations between offensive and defensive play (Sporis, Sango, Vucetic, & Masina, 2006). It is a team game that requires constant involvement of all 12 players and a high demand on their decision-making abilities (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). These alterations between the offense and defence are put down to the tactical elements of the teams play; the tactics can reflect the teams overall style of play. The importance of these tactics and style of play is debated heavily within research, with studies choosing to investigate which statistics should be tactically focused upon in matches. With the two teams constantly making alterations during a match it gives it a non-deterministic nature. This non-deterministic nature of basketball can be modelled as a dynamical system, with two sub-systems (i.e. opposing teams) along offence-defence situations (Bourbousson, Sève, & McGarry, 2010). These sub-systems organise their behaviours to maximise and minimise the scoring probability during offence and defence situations. During the plays, both teams use dynamics to move from one state to another, possibly ending in scoring opportunities or in blocking the attacks. When a team is attacking, many states can be used to create scoring opportunities; teams are able to transition between states. These transitions will be hereafter defined as dynamics (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011).

The successive co-ordination of movement of the basketball and the players around the defensive opposition represents the different states which a team can use to formulate an attack. These states have the properties of

describing the actions of players. To keep track of the game and for the purpose of later analysis of its details, has become standard, at least on a higher level, to encode all of the actions or distinctive parts in the form of an observational protocol (Nestke, 2004). This is done at a basic level in basketball with the play by play log, but in tracking the states and their transitions this would encompass more detail. A well developed ability to co-ordinate decisions among teammates is mandatory to increase the number of possible solutions a team can use against the opposition. It is expected that elite teams have more flexibility in their states and dynamics (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). The most important states for the offence are the ones that produce a rupture in the defence, creating empty spaces for scoring opportunities (i.e. terminal state of the system). These classes are defined as space creation dynamics (SCD). The SCD classes allow the evaluation of rupturing events, indicating the most efficient dynamics in disrupting the opponent's defensive system during a game and teams' offensive preferences along a competition (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). Analysing attack patterns, in particular the moves of other attacking players participating in a combination attacks (Nestke, 2004), is particularly useful within basketball as plays require co-ordinated attacks using a combination of players to cause a rupture in the defence.

The original study into SCD classes was carried out by Remmert (2003), he attempted to formulate space creation dynamic classes in a basketball offense. This study was done using very specific classes that had many subcategories, this made his model extremely complex and detailed. The large amounts of data accessed were unable to produce a generalised profile of performance from a high frequency of games due to the size of dependent variables. Using a regression based approach, using copious amount of data

could potentially give an accurate normative team profile (O'Donoghue & Cullinane, 2011). But the need for a re-think of SCD led to further work being carried out by Lamas, Rose, Santana, Rostaiser and Negretti (2011) where research led them to draw to a conclusion of a simpler to use model. Seven space creation dynamics were validated in basketball in order to attempt to indicate the most efficient dynamics. The seven classes involved a mixture of player involvement with anything from one to all five players being involved. These space creation dynamics can be used to evaluate and assess teams and how they strategise during a game. Another application would be statistical reports which could be used by coaches and players to assess defensive and offensive performances demonstrated both by the individual player and the entire team during a single game, the entire season, or a number of consecutive seasons (Ziv, Lidor, & Arnon, 2010).

The use of SCD also approaches a current contemporary issue within basketball. At present during a basketball game basic statistics are tracked during a match and placed into the box score (Score Sheet). Currently there are discussions among basketball analysts that the current box score doesn't give ascertain enough information for coaches to gain a larger retrospective of the game. Suggestions of expanding the box score to have further categories that give credit to players who create a rupture of the defence, creating empty spaces for scoring opportunities via screening is being debated. This is a type of SCD albeit in a simpler and generalised form. The elements of screening that matter most would have to be pinpointed if any screening stat were to be adopted onto the box score on any level and as it can be a pivotal point in any game, carrying the same weighting as an assist (Mahoney, 2013). The weighting of creating a rupture in the defence is debated but similar to how the

“hockey assist” gives credit to the player who made the pass before the pass that led to the goal; it is seen as an important part of the game. As the screen can create a scoring opportunity; which is similar to a good pass. This proposal has been brought about from the “plus-minus” statistic.

The “plus-minus” statistic is tracked on the advanced box score. This “plus-minus” statistic this takes into account how well the team does when a player is on the court (Pelton, 2007), traditional plus-minus statistic is that it does not control for the ability of the other players on the floor. All individual statistics are highly influenced by the context in which they are generated. A player’s teammates make him better or worse. Changing a player’s environment can easily change performance. This means that a player who is not well represented on the statistical box score but causes a rupture in the defensive system to create a scoring opportunity will gain a positive score, adding a screening statistic will give a numerical value for how many points which this player could be “responsible” for. Creating this rupture in the system is important as it gives a scoring opportunity. The frequency at which a player creates these rupture is seen a valuable commodity, as it shows both the tactical decision of both the player and their ability to work cohesively within the coaches offensive system. Up to now, there is no accepted way to transfer players’ internal tactical decisions into countable data. This is one of the main reasons why interactions between offensive and defensive players are poorly regarded by quantifying basketball game analyses (Remmert, 2003).

The use of quantifiable game statistics can be very useful when the coach wants to analyse team performance. This has lead more coaches into asking for specific analytical information in basketball so that they can train their players in both taking the higher percentage shots and to be able to force their

opponents to have a lower shooting percentage as well as increasing their turnovers. By analysing situational efficiency indicators it is possible to derive model values of team efficiency and individual player performance in defence and offense, as well as a comparison of players and teams, which is important for more efficient programming of the preparation process (Sporis, Sango, Vucetic, & Masina, 2006). The dynamics implemented may vary from game to game and during a game to overcome the opponent's strategy. Thus, the analyses of the possible dynamics used to solve the problem imposed by the opponent team may contribute to evaluate game strategies (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). The rates at least open the opportunity to draw conclusions concerning relations, dependencies, and patterns in the decisions of a team. This information for the team at the coaches' disposal the trainer could elaborate guidelines for the training. Additionally, knowing some of the facts concerning the opposing team from scouting analyses the coach is in a position to develop a successful match strategy (Nestke, 2004). SCD opens up a new category of statistic, opposed to looking at the how many times and event happens, it looks at how that event happened.

Group-tactical plays in basketball are influenced by both pre arranged and spontaneous decisions. The role of the coach in making these group-tactical decisions links the team and individual tactics in basketball training processes. The tactical abilities of basketball players possess an outstanding importance for game performance. Tactical competence allows highly effective acting in decisive situations of the basketball game to optimise the amount of scoring and defensive successes. Therefore the finishing actions of ball possession, in this case refers to the SCD or lack of (Remmert, 2003).

Identifying weaknesses within a team is considered the job role of both the coach and the performance analysis, by identifying the weaknesses training interventions can be put in place to attempt to improve the performance. If the level of the competition is low then large intervention strategies are required to attempt to raise the profile of that league. Quick fixes that would dramatically improve the performance of the league are often difficult due to the logistics or financial restrictions that are placed upon it. This is the case for the British Basketball League; the league is considered one of the worst leagues in Europe for the quality of Basketball. Interventions which could be put in place quickly to change this are to insource players from other league which could raise the calibre of the competition. British Basketball League rules currently allow for each team to have a maximum of three "import" players - from outside of the European Union (EU) and require a work permit to play - whilst the remaining players on the roster must have citizenship of an EU country, either by birth or by naturalization (BBL, 2013).

Yet by still allowing for three players outside of the EU and all the players from inside the EU including outside of Britain there is still a large enough field of players with the talent level to improve the leagues standard of play. The reason that more players aren't brought in is due to the financial restrictions which British teams have compared to the European counter parts. The average full time British Basketball league player requires full time employment alongside being an professional sportsman to be able to provide themselves with a good quality of life, something they do not have to do in other domestic leagues. In order to raise the standard of the game the talent development within the country needs to rapidly improve. If the BBL was able to improve its

commercial appeal, and draw more fans then it would have a higher chance of growing British talent and therefore retaining it.

Spanish basketball is held in high regard in terms of basketball. It is recognised as one of the country's most successful sports with them winning silver medals at the 2008 and 2012 Olympic games. In the Spanish domestic league (Liga ACB) competition, team can have 11 or 12 licenses. For 11-player rosters, minimum four players eligible for the National Team, two players from non-FIBA Europe countries (non mandatory) and the rest of players, from FIBA Europe countries (BBL, 2013). To try to improve the British Domestic league analysing the tactical and technical aspects that make up the Spanish Liga ACB would give players the opportunity to see where the difference lie. One of the aspects which is yet to be explored is the comparison of the SCD classes between leagues. The tactical development of the British league is imperative to the overall improvement of the league. By identifying which tactics differ it shows coaches which tactics are most effective, as well as giving the players the knowledge of which skills need to be improved upon to improve the competitive standard of the game.

The creation of two tactical performance profiles representing the British and Spanish domestic leagues, gives the opportunity for a direct comparison between the SCD of each. This is similar to work done in performance profiling, a conceptual tool used by scouts and coaches. Performance profiles gives opportunity for players to be critically analysed, stretching this tool to generalise to represent a leagues tactics is a novel concept which should be explored. A performance profile for a subject is a set of performance indicators with values based on the subject's typical performance rather than an individual performance (O'Donoghue, 2009). The style of play of one team in a match may

necessitate an effective opposing style be adopted by the other team. The performance of a team or individual may be influenced by the quality of the opposition as well as by their style of play. Relative strengths and weaknesses of teams (and individuals) who play against each other can dictate tactics in terms of situations to developed and avoid during the match (O'Donoghue & Cullinane, 2011). Player and team profiling is done frequently for scouting purposes but in this instance it is done for the purpose of identifying how the British League could adopt tactics and SCD usage of the Spanish League.

The insights to be gained on the basis of this analysis then will concern motion habits, technical skills, perception abilities, mental stereotypes, decision patterns, personal relations within the league (Nestke, 2004). By comparing teams from both the domestic British League and the Spanish League it will indicate which SCD classes are different between leagues. Analysing space creation dynamics within British Basketball would allow coaches to gain an understanding of the tactics which they employ throughout the domestic league, by comparing them to the highest ranked domestic league in Europe, (Spanish) it would allow an overview of the differences and similarities. From this it could emphasise the tactical deficiencies which the British Basketball League has compared to the Elite. It is necessary to analyse present elite basketball, especially within its tactical structures, to give young and talented players a better perspective on training, which is founded on objective data in addition to coaches' individual recommendations (Remmert, 2003). Providing the opportunity to young British basketball players to have objective data on the tactical preferences of elite teams would allow for better training and in turn a better standard of play. Therefore the purpose of this study is to compare the

differences in the space creation dynamic classes between the BBL and the Liga ACB.

Literature Review

Basketball is a sport which is played by more than 250 million worldwide in a structured competitive environment, this number increases largely if unstructured forms of the sport are also included (U.S. Department of State, 2013). The game of basketball was invented by Dr James Naismith in 1891 at a Young Men's Christian Association (YMCA) in Springfield, Massachusetts. The creation of basketball was a meticulous one, designed for the purpose of holding the Americans youths' attention (Brasch, 1972). Basketball caught on because graduates of the YMCA school traveled widely, Naismith disseminated the rules freely due to the need for a simple game that could be played indoors during winter. Ever since the game of basketball was introduced it has been a beloved sport by the American nation. The game has developed over time with original thirteen rules being changed and added to freely, up until 1934 when the rules were standardised (Guttman, 2004).

During its more recent history it has become more commonly recognised as a major sport outside of America, with the sport gaining support and huge favour in Europe (Guttman, 2004). Basketball remains immensely popular, not just in the United States but throughout the world (Cantwell, 2004) with it being currently one of the most popular sports in Europe, notably in Eastern Europe where a lot of research and advancements are being made (Cingiene & Laskiene, 2004). Eastern Europe embraced basketball at a very early stage of its development; with inter-country competitions being regularly held due to the Soviets inter country relations. A strong rivalry in the Soviet basketball market, between the Baltic States, Georgia, the Ukraine and the Moscow and St

Petersburg teams of Russia, led the way in Europe for many years (Cingiene & Laskiene, 2004). Western Europe has rapidly developed many leagues which are highly competitive, with the Spanish Liga ACB considered to be the best outside of the National Basketball Association (NBA) in Northern America (Euroleague, 2012). The Spanish Liga ACB was set up in 1983 and has since expanded into lower ability markets. This allows teams the opportunity to gain promotion through the leagues hierarchical system. Similar to the soccer leagues of Europe. This league expansion is common to all leagues outside of the NBA (Liga ACB, 2012). The NBA on the other hand affiliates itself with the NCAA to “draft” young players into the league straight out of college. A good example of basketball’s recent growth is in Belgium, with a 173% increase in the number of participants over the last 30 years (Van der Aerschot, 2004).

With basketball still being considered a new sport in Europe, rule changes and alterations to game play have been implemented as recently as 2000, where they brought in the twenty four second shot clock violation, opposed to the longer thirty seconds which was previously in place. Instead of two twenty minute halves, they were broken into four ten minute quarters (FIBA Europe, 2012). This was originally done in the NBA in an attempt to speed up the pace of the game to make it more appealing to the audience, in addition to gaining the multiple advertising breaks for broadcasting. There is a limited amount of literature published in relation to the modern European game, with the majority of studies into the European game being done prior to the change in the shot clock. The recent change in possession time from 30 to 24 seconds implied a full reorganisation from the strategic and tactical point of view, with particular influence on players’ cognitive and motor systems (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008).

The research which has been published with regards to the modern European game is primarily focused on exploring which game related statistic is highly correlated to winning and losing. Many researchers have examined the performance of basketball teams at different levels of competition such as European Basketball Leagues, American NBA, FIBA World Championships and Olympic Games (Karipidis, Fotinakis, Taxildaris, & Fatouros, 2001; Ibanez, Sampaio, Feu, Lorenzo, Gomez, & Ortega, 2008; Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Separovic & Nuhanovic, 2008; Lorenzo, Gomez, Ortega, Ibanez, & Sampaio, 2010). Due to the over publishing of these types of studies there is a general confusion to which of the indicators are the best for “Predicting” a game’s outcome. Some these key game related statics are defensive rebounds (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Trninic, Dizdar, & Luksic, 2002), assists (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Ibanez, Sampaio, Feu, Lorenzo, Gomez, & Ortega, 2008), two point field goal success (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Sampaio & Janeira, 2003), fouls (Sampaio & Janeira, 2003) and many more.

The inconsistency between studies could be due to a number of possible explanations; physical, psychological, technical, and the tactical make up the game of basketball, which therefore makes it difficult to predict future success using only one type of variable (Ziv, Lidor, & Arnon, 2010). Different statistical methods are used to examine the relationships between on-court performance variables and success, and therefore different studies yield different results. Another suggestion from Ziv, Lidor, and Arnon (2010) is that there was a lack of control for multicollinearity. It has been argued that multicollinearity (i.e. high correlation values between independent variables) can reduce the stability of the statistical model (Peat & Barton, 2005). This is seen as highly likely as some

of the analysed variables are very closely related to each other. Despite an inconsistent yield of results being generated from these research projects, there is a consistent field of participants being chosen to use for the studies.

This literature is limited to studies in Spain, Greece, Germany, Turkey, Lithuania and the VTB United League whose markets are rapidly expanding. There is currently no research that has been carried out into British Basketball; this is due to the severity to which British basketball is behind in both playing style and in dynamical flexibility. The British League currently falls out of the top 20 domestic leagues in Europe (Appendix B), of these domestic leagues 2 contain multiple countries, giving a total of at least 33 European country's domestic leagues which are ranked higher than Britain's (Euroleague, 2012). With the league being this far behind, it becomes difficult to bring in and retain players which could advance the leagues reputation. This has been emphasised with the funding for the 2016 Olympics being cut, although funding has now been given as long as strict performance criteria is met. With funding being withdrawn from British Basketball the development of the sport will be more problematic, a wide range of areas need developing in British Basketball to get it to a standard where funding will be restored. One of the areas which could help British Basketball advance is performance analysis.

Performance analysis is a field that is expanding in usage throughout professional sports, with teams utilising analysts to study many areas for improvement. These areas can stretch across a multitude of management branches, the most prolific being coaching and scouting. With the statistical analysis being so popular in the modern era of sports, the analytical break down of all aspects of sports is becoming more perceived as an aspect of normality. As the evolution of technology continues, so does the advancement of

performance analysts use of that technology. In the area of sport as a whole, there has been a shift towards increased use of technological and scientific innovation for instructional purposes (Katz, Libermann, & Sorrentino, 2001). This shift towards a scientific study of sports, has fuelled the work in many performance analysts fields, in an attempt to gain unbiased, objective scientific facts about players and teams. The continuing development of professional sports has led to an increased emphasis on the provision of technical scientific support to aid the coaching process (James, Mellalieu, & Jones, 2005). The use of technology to enhance coaching and performance has been recognised as an important and effective undertaking (Katz, 2001). Performance analysts are concerned with the analysis and improvement of sport performance. The practitioners make extensive use of video analysis and video-based technology (Hughes & Bartlett, 2010). The combination of technology and performance analysts drive for information, is leading to greater sets of data on both individuals and teams.

By gaining these advance data sets on both players and teams it has lead to an inquisitorial desire to compare players and teams on a statistical level. To do this performance analysts use performance indicators. A performance indicator is a selection, or combination, of action variables that aims to define some or all aspects of a performance. Analysts and coaches use performance indicators to assess the performance of an individual, a team, or elements of a team. Often they are used in isolation as a measure of the performance of a team or individual alone (Hughes, 2004), but there has been an increase in the comparison of these performance indicators to the athletes peers. The comparison between performers and the scientific break down of

players is assisting the ever striving desire to create a database of information on all players for multiple coaching purposes.

Although a solution to a need was found using performance indicators by retrieving accurate statistics. The importance of these statistics has been questioned to the overall result of team performances. The request for statistics to be able to predict match outcomes has become increasingly asked for. The measurement issue that remains is the weighting problem of how to determine the relative importance of different player actions toward overall match outcomes. The desire to be able to compile all of the statistics generated from a player's performance into one number which would directly relate to the outcome of a match is seen as the Holy Grail in modern sports. There are two general types of solution to the weighting problem—a subjective, judgment-based approach or a more “objective” statistical approach. The subjective judgment-based approach involves an expert developing a weighting system based on their own experience and judgment (Gerrard, 2007). This approach can be favoured by coaching staff as it lets them have more involvement with the performance analysts and lets them create a team around their own ethos. Although it can be counterproductive as the performance analyst can gather all the objective data for the coach to then place an emphasis on a statistic which is not related to a match outcome but feels it matches the ethos of the team.

The statistical approach involves the determination of an appropriate set of weightings by estimating the degree of statistical association between match outcomes and the number of different types of player actions using a sample of games (Mason & Foster, 2007). The most popular method of doing this is the multiple regression approach which has been done extensively in attempts to

research which statistic closely relates to match outcomes. Problems with multiple regression approaches are that the actions which have a more direct link with the match outcome will show as having a high correlation e.g. two point field goal made (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008). So players which specialise more in the higher correlation statistics will tend to receive disproportionately high estimated win contribution compared to players specialising in lower correlation actions if a purely statistical approach is adopted with no recognition of the player of dependencies in these actions (Gerrard, 2007). Not all actions have a performance indicator yet these actions can be equally valuable in the match outcome, including: hustle, leadership, conditioning, denial defence, help defence, taking charges, setting screens, boxing out, and causing deflections (Eldridge, 2010), this will not be a performance indicator but could be equally valuable in the match outcome. It is quantifying these statistics into a hierarchical model alongside the game related statistics which the challenge in modern day performance analysis.

The use of performance analysis in determining many aspects of the coaching role is a concept which is becoming more publicly acknowledged. This is largely due to the success of book and film “Moneyball”, which describes a story of Billy Beane, the owner of baseball team Oakland Athletics. Beane used a concept of sabermetrics brought about by a Bill James (James B. , 2011). Sabermetrics can be defined as employing statistical analyses in order to apply objective knowledge to baseball (Wolfe, Wright, & Smart, 2006). Describing how by using performance analysis was able to take advantage of a market for baseball players that systematically distorted their value. Baseball traditionalists over-paid for players that would ultimately sub-optimally contribute to team wins (Gerrard & Howard, 2007). Analysts devised new measures of player

performance, including an attempt to combine multiple offensive categories to determine how many runs a player contributes to team outputs (Gietschier, 2005). Focusing on statistics which had a high correlation with team wins and found they were able to identify undervalued talent (Eldridge, 2010).

Since then analysts in all sports have spent time seeking a new “Moneyball” hypothesis applicable to their respected sports. Teams that are willing to break the conventional moulds of player valuation will be able to maximize the value of their payrolls and capture significant gains in on-court productivity without having to spend exorbitant amounts of money (Gerrard, 2007).

The one on one interactions between the “pitcher/bowler” and “Hitter” makes it easier to accurately assess the individual's production on the team, and therefore his market value. Invasion team sports are much more complex. Invasion team sports involve a group of players co-operating to move an object to a certain destination, the way in which this can occur is able to vary depending on many factors (Gerrard, 2007). The range of player actions is much greater and includes tackling to regain possession, moving the ball forward via passing, receiving, running and/or dribbling, and attempting to score by shooting or crossing the line. As of yet there does not yet appear to be a singular statistic (such as baseball's on-base percentage) in other sports that can be used to develop a formula like James' runs created statistic (Gietschier, 2005). The sport which dedicates most time and resources to this is basketball.

Unlike other complex invasion games, basketball has embraced analytics; this is likely due to that it has always been a game which is considered stats heavy. This history of statistics has made it easier for basketball accept performance analysis as it sees statistics as part of its

historical culture. Quantitative analysis of basketball performance, particularly through game statistics, is being widely used among coaches in order to analyse game events with more valid and reliable data (Sampaio & Janeira, 2003). The analysis of the game-related statistics is very popular among coaches; however, only recently has scientific research been available on the usefulness of these variables in characterising and understanding game performances under different contexts (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008). The use of statistical reports to measure on-court performances of basketball players (e.g. percentage of shooting success, number of rebounds, and number of steals) has become a common practice in professional and amateur leagues. These statistical reports are used by coaches and players to assess defensive and offensive performances demonstrated by the individual players (Ziv, Lidor, & Arnon, 2010).

The vast quantity of work has mainly been carried out on performance indicators that are recorded on the box score these are typically done in game by statisticians. These typically consist of minutes played, points scored (Field goals made and attempted), assists, rebounds (defensive and offensive), steals, blocks, fouls, turnovers and free throws (made and attempted) (BBL, 2012). Indicators are subsequently then worked out into field goal percentage, three point percentages and free throw percentage which also commonly appear on the box score (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008). This is because they have a direct relationship to the match outcome it is simpler to understand how points scored relates to the final score of a match compared to defensive rebounds.

A lot of studies try to calculate the worth of these statistics either individually or in terms of how each statistic can help a team win games using

linearity weighting or adjusted plus minus. By analysing situational efficiency indicators it is possible to derive model values of team efficiency and individual player performance in defence and offense, as well as a comparison of players and teams, which is important for more efficient programming of the preparation process (Sporis, Sango, Vucetic, & Masina, 2006). It is becoming increasingly popular for new statistics to be invented to summarise performances such as the new player efficiency rating algorithm in which complex equations take into account the pace of the game compared to averages for the competition (Hollinger, 2006), evidently inspired by Bill James doing similar in baseball.

The most important insight to come out of the work of Hollinger (2006) and Oliver (2004) is the idea of using possession-based analysis to measure the effectiveness of teams and individual players in the NBA. Normalising the data to make it standardised to the entire game is becoming a very popular method as it allows coaches to see which players or teams performs. Possessions are guaranteed to be approximately the same for two teams in a game (within two for a non-overtime game), so possessions provide a useful basis for evaluating the efficiency of teams and individuals. To win, teams and individuals try to score more points per possession than their opponents (Kubatko, Oliver, Pelton, & Rosenbaum, 2007). Although often the key in many of the modern day advance statistics, possession is not tracked on the box score or anywhere else. It can be worked out from play by play logs, but outside of the elite leagues these are uncommon. Possessions can also be estimated using commonly available box score data. A general formula to estimate possessions for team t ($POSS_t$) is:

$$Poss_t = (FGM_t + \lambda FTM_t) + \alpha [(FGA_t - FTM_t) - OREB_t] + (1 - \alpha) DREB_o + TO_t$$

where $FGAt$ is field goal attempts for team t , $FGMt$ is field goals made for team t , $FTAt$ is free throw attempts for team t , $FTMt$ is free throws made for team t , $OREBt$ is offensive rebounds for team t , $DREBt$ is defensive rebounds for opponent o , TOt is turnovers for team t , h is the fraction of free throws that end possessions, λ is the fraction of free throws that end possessions and α is a parameter between zero and one (Kubatko, Oliver, Pelton, & Rosenbaum, 2007). This was then simplified by Hollinger (2006) for coaches to gain quicker access to advance statistics to:

$$POSS_t = 0.976 \times (FGA_t + 0.44 \times FTA_t - OREB_t + TO_t).$$

(Hollinger, 2006)

Although this was criticised by other analysts as it did not place any value on defensive rebounds. This was considered an large advancement on a similar system implemented by Turcoliver, (1991) who used $\text{ball possessions} = (\text{field-goals attempted}) - (\text{offensive rebounds}) + (\text{turnovers}) - 0.4 (\text{free throws attempted})$. Despite the research which has gone into attempting to accurately formulate the possessions, most researchers and statisticians use the average of 91.7 possessions for each team per game as correlations with actual possessions are quite similar; there is not a lot of payoff from using the complicated equations (Kubatko, Oliver, Pelton, & Rosenbaum, 2007). They do this as the best teams are not those that score the most points or allow the fewest, but rather the teams that are able to acquire and efficiently use possessions, while preventing their opponents from doing the same (Eldridge, 2010). This lead to the per possession rating which is commonly used amongst

many members of the media to try to educate the spectators on the differences in strengths of teams. It has been recently used in simulator games to try and predict the results of matches to give betting odds.

$$\text{Offensive Rating (OR}_{tgt}) = PTSt/POSSt \times 100$$

$$\text{Defensive Rating (DR}_{tgt}) = PTS_{o}/POSS_{o} \times 100$$

The premise behind these newer statistics is that they more effectively measure productivity on the team and take into account what factors actually contribute to on-court success and then thoughtfully devising means to successfully quantify those factors.

With basketball having a roll on roll off substitution system it use to be hard to assess how well a player would compare with another, due to the time that they were on court most likely being different. Statistics calculated on a per-minute basis tend to be fairly consistent even when a player's minutes played are variable. This allows for direct comparisons of starters and reserves that play fewer minutes (although they must register a minimum amount across the season to be valid, otherwise anomalies will occur). This is one of the rare statistics that even though created for the purpose of the NBA, the calculation is done using the length of the European game so that players from Europe can be compared to the NBA players. The use of per-minute statistics allowed analysts to identify young players that could potentially replicate their success they have had in small minutes to longer court time (Hollinger, 2006).

The most successful advance statistic in terms of being publicly acknowledged in basketball is the "plus-minus" statistic this takes into account how well the team does when a player is on the court (Pelton, 2007). This statistic has been accredited for many players successful longevity in basketball, to the extent which it has now been placed on the NBA box scores.

It measures the team point differential when a particular player is in the game; plus/minus statistics are often measured on a per-minute or per-possession basis. Setting effective screens, the ability to spread the floor, and playing good help defence are all examples of skills that theoretically are accounted for by plus/minus statistics that are not captured by individual player statistics.

Plus/minus statistics measure how a team performs when a given player is on the floor, so they are, in essence, the individual player version, of the team efficiency differential (Kubatko, Oliver, Pelton, & Rosenbaum, 2007). All individual statistics are highly influenced by the context in which they are generated. A player's teammates make him better or worse. A player's coach can do the same. Changing a player's environment can easily change performance. A player's talent level changes only with age, injury, experience and state of mind, but what you see on the court is the product of talent and context (Oliver, 2004).

Therefore the plus minus has since advanced to account for who is on the opposing team and the per-forty eight minutes; this is called the "adjusted plus-minus". The interesting thing about adjusted plus-minus ratings is that they do not utilize box score statistics, meaning that one does not know exactly how a player produces their adjusted plus-minus statistic just that, when he is on the court, his team is a given number of points better than if he was replaced by an average player (Rosenbaum, 2004). The primary downfall of adjusted plus-minus is that in some cases there can be a great deal of statistical noise associated with the ratings that calls the legitimacy into question. (Eldridge, 2010).

Performance indicators which have been manipulated into producing ratings are evolving in sport to show an overall production of an individual

player contribution. Two statistics have shown a strong positive correlation between a statistical value and wins. Efficiency rating and wins produced. These statistics are produced using calculations from the team's standard box score of statistics. All of these statistics only allow players to increase their rating by taking more shots if they shoot a higher than 33.3% from three point range and above 50% from two point range. A player who scores many points but takes a high volume of shots has a low efficiency. With basketball being such a high scoring game the efficiency of a player is important (Eldridge, 2010). Players who fail to shoot efficiency are wasting possessions and hurting a team's chances to win (Berri, Brook, & Schmidt, 2007).

Oliver (2004) normalised individual possession rates similar to team possession rates so that individual players, on average, use one fifth of the team's possessions while they are on the floor. Players use up their easy opportunities to score on dunks, lay-ups, and wide open shots. However, as they increase their possession usage beyond those shots (and assists), the quality of the opportunities fall. But they fall at different rates for different players. Moreover, teams adjust their defensive strategies to reduce the efficiency of the players most likely to be able to shoulder a higher possession rate (Kubatko, Oliver, Pelton, & Rosenbaum, 2007). Although this raw statistic shows a strong positive correlation to wins it is not yet at a stage where players are judged upon it.

Wins Produced uses ordinary least squares regression techniques with team wins as the dependent variable and traditional box-score data as the independent variables to determine how traditional box score statistics correlate to team wins (Schmidt & Berri, 2010). Schmidt and Berri (2010) use the correlation coefficients from this regression to calculate a player's production

and then scale this production value on a per-48 minutes basis. The interesting thing about the wins produced metric is that when individual wins produced are summed across a team, the average difference between predicted team wins produced and actual team wins is 1.7. This is a strong indication of the method's power to quantify exactly how much an individual player contributes to his team's success. Wins Produced fails to properly capture a player's defensive contributions due to the lack of effective defensive statistics contained in traditional NBA box scores (Winston, 2009).

All of these statistics and many more are used in advanced performance analysis to be able to compare all players against one another. This is because from a theoretical perspective all players have an equal opportunity to ascertain all stats which are recorded on the box score. Yet each player will play with a different style of play, they might be the same categorical position but not be specialised in the same skill set. For example, a basketball guard can have a number of playing styles, among them penetrating and passing, penetrating and shooting, and playing mostly at the backcourt. These individual styles of playing, namely the indicators of *how* the player actually plays, can be related to such on-court statistics as the number of fouls he received, the distance he covered during the game, or the frequency of his vertical jump performances. To some degree, the indicators of how the player plays can also influence some of his on-court statistics. However, it is recommended that when trying to predict success from on-court statistics, the variables that can be related to how well the players play are the main ones to consider (Ziv, Lidor, & Arnon, 2010). Before we are able to access players in a generalised field, we won't be able to sub categorise to position and playing style, which could potentially be a great

asset in compiling a team. One method of potentially getting to this point in performance analysis is by analysing beyond the box score.

Currently there are discussions among basketball analysts are that the current box score doesn't take for enough information for coaches to gain a larger retrospective of the game. Suggestions of expanding the box score to have further categories that give credit to players who create a rupture of the defence, creating empty spaces for scoring opportunities via screening (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). This proposal has been brought about from the "plus-minus" statistic which is tracked on the advanced box score. This means that a player who is not well represented on the statistical box score but causes a rupture in the defensive system to create a scoring opportunity will gain a positive score, adding a screening statistic will give a numerical value for how many points which this player could be "responsible" for. Creating this rupture in the system is important as it gives a scoring opportunity.

Using space creation dynamics as an alternative to the play by play log would give coaches more specific analytical information so that they can train their players into taking the higher percentage shots and to be able to force their opponents to have a lower shooting percentage as well as increasing their turnovers. The usual way of obtaining performance indicators for game analysis does not consider the dynamic interactions of which they are comprised (Lames & McGarry, 2007). These analyses focus on relative frequencies of game actions occurrence, which do not support understanding the sequential context of the game (Hughes & Bartlett, 2010). SCD classes provide objective criteria for the assessment of the sequential nature of the rupture events that may lead to scoring opportunities (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011).

Due to the amount of possessions which occur in basketball and the tactical needs of teams there is a high recurrence of SCD classes during basketball games.

The use of SCD is still a contemporary issue in terms of literature, yet it may expand the tactical understanding of basketball on a large scale. Studies which analyse specific phases of basketball play such as fast-breaks (Mexas, Tsitskaris, Kyriakou, & Garefis, 2005) could analyse the individual and group interactions which lead to the fast-break opportunity. Looking at how the team dynamic is structured allows a focus on not just the description of the statistics but can place them in the context at which they are achieved. Scouting an opponent's playbook is seen as a difficult task but by analysing the SCD that a team uses and matching that with the location at which the scoring opportunity occurred would allow coaches to extensively prepare teams to compete against opponents.

When placed into a practical circumstance to investigate how teams in the 2008 Olympic Games distributed their SCD classes it was made evident the potential degree of information that could be gleaned from future study. With 87% of all ball possessions resulting in oppositions occurring in half-court set offence situations, with 68.7% of them ending in scoring opportunities after a SCD (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). The most prevalent SCD was the Onball screen (OnBS) (34.8%). The prevalence of the OnBS is possibly related to its efficiency in providing sufficient space for shooting in a small time window (Angel, Evangelos, & Alberto, 2006).

Similarly to how determining the SCD classes used by the elite teams' would allow unravelling some aspects of the offensive strategies of these teams, which could have helped coaches to elaborate their game strategies

(Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). Instead of placing indirect competition with these national teams, by attempting to duplicate the style the elite teams play at could mean a substantial rise in performance for lower teams.

Analysing space creation dynamics within British Basketball would allow coaches to gain an understanding of the tactics which they employ throughout the domestic league, by comparing them to the highest ranked domestic league in Europe, (Spanish) it would allow an overview of the differences and similarities. From this it could emphasise the tactical deficiencies which the British Basketball League has compared to the Elite. The ACB's elite status suggests that it will have greater flexibility in its states and dynamics. Whilst also utilising more SCD involving more on the ball and off the ball screening by possessing greater state of player co-ordination. Therefore the purpose of this study is to compare the differences in space creation dynamics occurrences between BBL and Liga ACB. The secondary purpose of this study is to explore the location of these differences. It was hypothesised that the elite league (ACB) used more SCD classes which had higher player involvement (On ball screen and out of ball screen) compared to the lower league (BBL) that used single player involvement such as space created off the dribble or perimeter isolation.

Method

Participants

Twelve games from the 2012/13 season from the British Basketball league were analysed. Four of the games were recorded live, after permission was gained from the club to be involved for the purpose of this study. Eight of the games were taken from BskyB broadcasting footage which is publicly available. The four games which were recorded live were made up of games from one team's opponents over a four week period, where possible games were recorded from an elevated position for better court vision and to closely replicate the BskyB footage. The BBL is made up of eleven teams that face each other in league competition three times per season. All twenty-four teams were analysed, with one single team not being analysed more than four times. Twelve games from the 2012/2013 season from the Spanish League were analysed with all twelve games coming from domestic broadcasts, which are publicly available. There are eighteen teams in the Spanish League which compete three times a year against each other. All twenty-four teams were analysed with one single team not being analysed more than four times.

Equipment:

The method of direct observation was employed and the following equipment was used to record the games.

- Tripod for stabilisation of the camera
- Camera for recording of the games to SD card
(CanonMV890,Tokyo,Japan)
- Apple Mac OS X
- "Dartfish" program for the analysis of the digital video

Procedures

The protocols set out for the Lamas, Rose, Santana, Rostaiser, and Negretti, (2011) study were followed. The protocols refer to how to define different SCD and what defines a new SCD possession; Ball possession was defined as the period of the game starting when a team has the control of the ball until the other team takes the ball under their own control (Oliver, 2004). In case of fouls, it is considered a new possession when the foul occurred during a shot attempt and the space creation recorded. In case of offensive rebounds, both after a free throw or a “live-ball” shot, if an immediate shot was taken after the rebound was captured, it did not characterise a new possession. However, if a pass occurred after the rebound or the rebounder created space before shooting the ball, it was annotated as a new ball possession. For analysis purposes early offence and secondary offence were considered together as a half-court offence. Fast breaks were not considered as a SCD as the defensive system was never in place for the offence to rupture it, therefore no SCD took place.

The classes were judged based on the differences of the decisional context codified as “if <situation>, then <action>” (Fotinakis, Laparidis, Karipidis, & Taxildaris, 2002). Three criteria were considered to discriminate the actions. First, the number of players, representing an objective measure of inter-personal coordination. Second, the type of technical skill used, which described the chosen motor solution to a given context. And third, the decisional context, which indicated the presence or absence of an a priori collective coordination before the SCD execution (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). The seven performance indicators for the space creation dynamics were taken from Lamas, Rose, Santana, Rostaiser and Negretti (2011) definitions:

1. *Space Creation with Ball Dribbled (BD)*: individual actions when the space to take the shot is created by the player who is dribbling, without the cooperation of teammates
2. *Space Creation with Ball not Dribbled (BND)*: similar to *BD* but without a dribble, using only body displacements techniques (i.e. ball fakes)
3. *Perimeter Isolation (Perl)*: player with the ball is isolated in the perimeter, usually in the central area of the half offensive court while the other four teammates position themselves in the wings and corners of the court to force the defensive players to move away from these positions and, therefore, maintain the distance from the player handling the ball.
4. *Post Isolation (PostI)*: similar conception of *Perl* but occurring in the post area, close to the key. Both *Perl* and *PostI* are particular cases of *BD* or *BND* because the space is created in a 1x1 situation. However, they were considered separately because of the coordinated team action that characterizes a different decisional context, where the whole team had a synchronized decision about the behaviour to be implemented.
5. *Space Creation Without Ball (WB)*: consists in a two players action and when one of them creates space, receives a pass from the teammate (i.e. back-door situations)
6. *On Ball Screen (OnBS)*: one of two players position himself in the trajectory of the defender of his teammate with the ball, interrupting the

defender's line of displacement (i.e. screen), thus creating space (i.e. called pick and roll situations)

7. *Out of Ball Screen (OutBS)*: similar to *OnBS* but both players involved in the screen do not have the ball. After the defender trajectory has been interrupted by the screen, a third offensive teammate passes the ball to the teammate with no defender.

A visual representation of each performance indicator was also used alongside the definition during analyses for both the researcher and the inter-rater reliability testing (See Appendix C). Many different SCDs may occur during a single ball possession. However, only the ones leading to scoring opportunities were considered because it represents the instant that the defensive team could not cover the spaces necessary to avoid the offence to progress to a scoring opportunity. Only in events that the offence was able to cause a rupture in the defensive system to have a scoring opportunity was considered to be SCD. Each SCD scoring opportunities location was recorded using the shooting grid used by Tavares and Gomes (2003).

Figure 1: Zone Location grid (Tavares & Gomes, 2003)

Statistical Analysis

Intra and inter-rater reliability test

Intra reliability testing was completed analysing a random full match from the study using the methods of Cooper et al. Inter reliability testing was also done using level two qualified coach who analysed a random game. A gold standard confidence level was sought after of 90-100% at a reference value of ± 1 . The coach could watch the plays as many times as necessary, even in slow motion, to increase the precision of the judgment.

Data Analysis

A multivariate analysis of variance was used to determine if there is a significant difference between any of space creation dynamic performance indicators between the British Basketball League and the Spanish Liga ACB. A one-way between groups multivariate analysis of variance (MANOVA) was performed to investigate the differences between the BBL's and ACB's use of SCD techniques. The seven dependent variables used were: SC Ball Dribbled, SC Ball not Dribbled, SC without Ball, On Ball Screen, Out of Ball Screen, Post Isolation and Perimeter Isolation. The independent variable used was the domestic league which the games were played in. A Kolmogorov-Smirnov univariate and Mahalanobis distances multivariate normality tests were performed on all variables. As seven SCD performance indicators a critical value of 24.32 is used (Tabachnick & Fidell, 2013). Univariate and multivariate outliers were assessed as being not detrimental to the statistical analyses therefore were left in the study. Multicollinearity test was performed and as none of the variables directly relating to the hypothesis were highly correlated (0.8 or 0.9) none were removed. A small sample sized was used and the box test of

Equality of Covariance matrices was violated, but due to using two groups a Wilks Lambda statistic was used. A Bonferroni adjustment was used on the original alpha level of $p \leq 0.05$ giving a new alpha level $p \leq 0.007$. Partial Eta Squared test was used to acquire the effect size. The statistical analysis was performed using SPSS software 20.

Results

Intra and Inter-rater Reliability

Intra- and inter-rater reliability was performed using the Cooper et al (2007) method. The SCD techniques were analysed using sixteen time cells of two minutes thirty seconds each. The intra- and inter-rater reliability testing shows there was no systematic bias for the testing with all indicators being greater than $P = >0.05$ for any of the seven indicators. The Cooper et al. (2007) intra and inter reliability test shows that five of the seven performance indicators had 100% proportions of agreement at ± 0 . The intra reliability test produced two discrepancies, which were from SC Ball Dribbled ($P=1(0.5)$, $PA=93.75\%$, $CI\ 81-100\%$) and SC without Ball ($P=1(0.5)$, $PA=93.75\%$, $CI\ 81-100\%$). The Inter-rater reliability also showed discrepancies with SC Ball Dribbled ($P=1(0.688)$, $PA=75\%$, $CI\ 54-96\%$) and SC without ball ($P=1(0.5)$, $PA=93.75\%$, $CI\ 81-100\%$).

Complying with the Cooper et al (2007) methodology to ensure that the majority of time cells having a frequency count within them, the zones were grouped into outer range (1,2 and 3), mid range (4,5 and 6), close range (7 and 9) and under the basket (8). The intra- and inter-rater reliability testing shows there was no systematic bias for the testing with all indicators being greater than $P = >0.05$ for any of the twenty eight performance indicators and zones. Yet as the reference value was set at ± 1 the confidence interval for all performance indicators is 100% meeting the gold standard criteria (See Appendix D).

Table 1: Intra Rater Reliability

SCD Class	Median (sign test P)	Percentiles			Confiden ce interval (%)	PA \pm 1 (%)	Confiden ce interval (%)
		2.50 %	97.50 %	PA = 0 (%)			
SC Ball Dribbled	1 (0.5)	2.62 5	0.625	93.7 5	81-100	100	100
SC Ball not Dribbled	1 (1)	0	0	100	100	100	100
SC Without Ball	1 (0.5)	2.62 5	0.625	93.7 5	81-100	100	100
On Ball Screen	1 (1)	0	0	100	100	100	100
Out of Ball Screen	1 (1)	0	0	100	100	100	100
Post Isolation	1 (1)	0	0	100	100	100	100
Perimeter Isolation	1 (1)	0	0	100	100	100	100

Table 1: Total frequencies and Percentage of possessions and how they ended

	Total Possessio ns	Half court offence s which ended in a SCD	Half court offence with no SCD/Forc ed shot	Free throws off team fouls/Technic al fouls	Fast- break s	Turnover s
BBL	1977	(1326) 67.07	(99) 5.01	(42) 2.12	(186) 9.41	(324) 16.39
AC B	1816	(1242) 68.39	(114) 6.28	(73) 4.02	(99) 5.45	(288) 15.86
Tota l	3793	(2568) 67.70	(213) 5.62	(115) 3.03	(285) 7.51	(612) 16.14

Half-court set offences ended in: a) scoring opportunities after a SCD (2568-67.7%); b) forced shoots/non-SCD (213-5.62%); c) free-throws (115-3.03%); d) fast-breaks (285-7.51%) and e) turnovers (612-16.14%). Each leagues possession usage and percentage can be found in table 1.

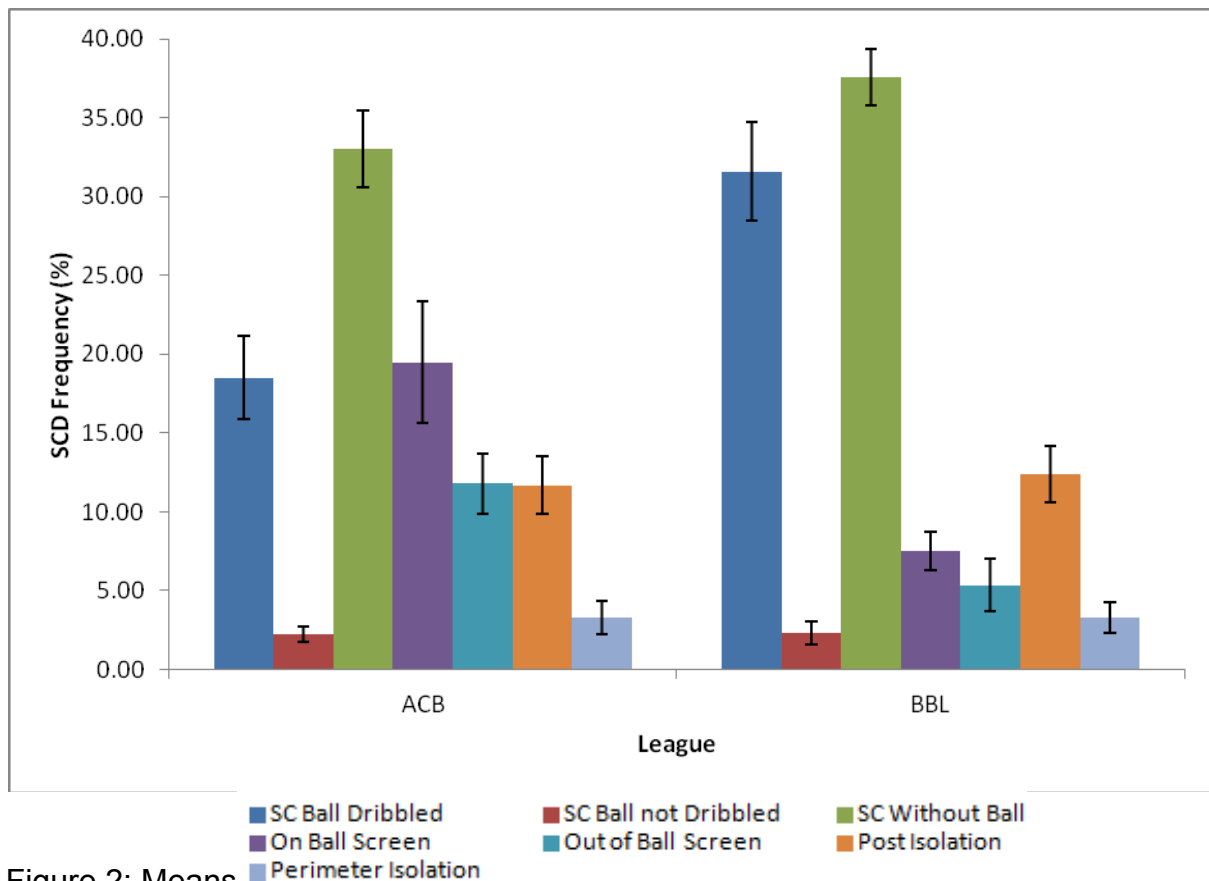


Figure 2: Means

There was a statistically significant difference between BBL and ACB on the combined dependent variables, $F(7, 16) = 6.76$, $p = 0.001$; Wilks Lambda = 0.25; partial eta squared = 0.747. When the results for the dependent variables were considered separately, the differences to reach statistical significance using a Bonferroni adjusted alpha level of 0.007, was Space Created ball Dribbled, $F(1, 34.23) = 30$, $p = 0.000$, partial eta squared = 0.58, On Ball Screen, $F(1, 32.5) = 26.56$, $p = 0.000$, partial eta squared = 0.55 and Out of Ball Screen, $F(1, 12.68) = 19.58$, $p = 0.000$, partial eta squared = 0.47. An inspection of the mean scores indicated that BBL reported a higher SC ball dribbled ($M = 31.6$, $SD = 1.69$) than the ACB ($M = 18.52$, $SD = 1.69$). Whereas the ACB reported higher On ball Screen ($M = 19.5$, $SD = 1.65$) than the BBL ($M = 7.5$, $SD = 1.65$) and a Out of Ball Screen ($M = 11.79$, $SD = 1.03$) to the BBL ($M = 5.36$, $SD = 1.03$).

Table 3: Zone location distribution

		1		2		3		4		5		6		7		8		9	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
SC Ball Dribbled	BBL	1.7	2.1	3.9	3.9	4.0	3.4	5.3	3.2	15.9	7.6	5.2	4.1	7.8	4.6	49.1	8.5	7.0	3.3
	ACB	2.3	3.8	6.6	3.6	4.1	4.5	7.5	6.2	15.2	13.5	7.4	7.3	6.5	3.8	45.8	10.5	4.6	4.0
On Ball Screen	BBL	11.9	17.2	14.4	11.7	15.1	19.2	6.0	12.0	8.6	9.7	3.6	5.6	8.9	12.8	26.0	13.7	5.6	9.6
	ACB	4.6	4.4	16.7	8.6	5.9	5.7	8.8	7.6	12.3	7.5	8.8	10.1	3.8	4.5	32.0	14.9	7.1	8.6
Off Ball Screen	BBL	14.6	18.4	26.1	29.8	14.9	16.8	7.6	16.5	9.1	12.9	4.8	14.4	6.5	9.6	12.3	19.3	4.1	8.3
	ACB	11.1	9.4	20.8	13.6	12.7	12.5	7.7	7.9	10.2	12.0	9.1	6.8	10.8	10.2	12.6	11.5	5.0	5.7

Three one-way between groups multivariate analysis of variance were

performed to investigate the differences between the BBL's and ACB's use of SCD that presented a significant difference from the original MANOVA (Space created Ball Dribbled, On the Ball Screen and Off Ball Screen) in all shooting grid zones. Testing showed there was no statistical significance between any of the three SCD techniques distribution of location. This states that although there is a significant difference in the SCD techniques frequencies, the location distribution is not statistically different for any of the three SCD.

Discussion

The aim of the present study was to examine the differences in the frequencies of the SCD classes used between the British Basketball League and the Spanish Liga ACB; and to examine any dissimilarity between the zone locations of those differences. It was hypothesised that the Spanish Liga ACB would contain more flexibility in the states of their dynamics and would be able to co-ordinate states which required higher player participation. This would be represented in the Spanish Liga ACB having a higher possession frequency percentage of on the ball screens and out of ball screens. The lower ability, British Basketball League would have less flexibility in their states of dynamics and would therefore be more reliant on single player SCD classes. The BBL would have a higher percentage of possessions which were space created off of the dribble and perimeter isolation.

The results of the current study showed that of the 3793 possessions analysed that these consisted of 67.7% half court set offences ending in a SCD, 5.62% half court offence with no SCD or a forced shot, 3.03% free throws off of team fouls or technical fouls, 7.51% fast-break opportunities and 16.14% with a turnover. Segregating these statistics into the individual leagues it reveals the similarities of the overall percentages between the leagues. The average percentages of the leagues possession usage was close despite the assumed difference that the leagues play at different paces, and would therefore have drastically different possession totals. The largest percentage difference was in fast-break opportunities with a 3.96% difference between the domestic leagues. The results of the current study allow the conclusion that the pace and basic

elemental components of the games between the leagues are very similar. Due to the propinquity of the league comparison data, it exposed the redundancy of normalising the game statistics to 100 possessions to control for game rhythm to compare both leagues. Although this may have increased the validity of the analysis, it was considered to make the data more comparable to the results of most current studies (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008).

A previous study investigated how the usage of possessions varies between countries. Lamas, Rose, Santana, Rostaiser and Negretti (2011) study, found scoring opportunities after a SCD 68.7%, forced shots/non-SCD 8.6%, free-throws 4.8% and turnovers 17.9%. This study was done analysing the quarter finals of the 2008 Olympic Games (eight national teams), revealing that the overall possession usage can be shown to be consistent when analysing many basketball teams. This allows the conclusion to be drawn that although the BBL may be considered to be a worse league than many others, the possession usage is still on equivalence with other elite teams/leagues. As the data suggests it can be useful for performance analysts who will be able to extrapolate data from different studies for comparison purpose without having to normalise it.

Not all studies concur with these figures, particularly those which are researching fast-breaks. Outside of the half court set offence the most thoroughly researched area is the fast-break offence. Studies which have focused on the fast-break generate a higher frequency of occurrence of the fast-break in possession usage. When analysing the possession usage of under 16 year old basketball, studies found that that 25.4% of all offences were made up of fast breaks and 74.6% were made up of set offences (Tavares & Gomes, 2003). This is higher than what Silva (1998) reported, that 15% of field goals

successes were scored in fastbreak situations. This large difference between the studies is likely due to the performance indicator definitions. The importance of clear performance indicators has been heavily reported (Lames & McGarry, 2007) to avoid such discrepancies. The difference between a fast-break and a half court offensive set is key in determining the possession usage. The difference being defined as, half court set as offences have duration between 13 and 20 seconds, with anything under being a fast break or anything over being a forced shot (Gomez, Ortega, Lorenzo, Ibanez, & Sampaio, 2010). The current study defined a forced shot as any field goal attempt in which the player did not create space to take the shot and was required to shoot to avoid a shot clock violation, regardless of successful or unsuccessful.

With the majority of offensive possessions ending in a half court set it is justifiable for this to be the section which research has been predominantly focused upon (Bourbousson, Sève, & McGarry, 2010; Cruz & Tavares, 1998; Csataljay, O'Donoghue, Hughes, & Dancs, 2009; DeRose, 2004; Chin, Huang, Tang, & Hung, 2005). Studies which have focused upon determining which statistic discriminates between winning and losing teams have become increasingly common producing a vast range of results depending on their subjects. Some of these key game related statistics are defensive rebounds (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Trninic, Dizdar, & Luksic, 2002), assists (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Ibanez, Sampaio, Feu, Lorenzo, Gomez, & Ortega, 2008) and two point field goal success (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008; Sampaio & Janeira, 2003), to name a few. These statistics are all related by the half court offence, suggesting that to fully understand the half court offence, further analysis into how these statistics happen was required.

The results identified several statistical differences between the SCD classes used between the BBL and Liga ACB; Space Created ball Dribbled, On the ball Screen and Off the Ball Screen. The offensive half court set SCD class usage between the BBL and the Liga ACB was not statistically different for; Space Creation with Ball not Dribbled, Perimeter Isolation, Post Isolation and Space Creation Without Ball. The BBL showed a significant statistical reliance on space created ball dribbled than the Liga ACB, with 31.6% of the its half court set offences being generated from it compared to the 18.5% of Liga ACB. The Liga ACB had a higher usage of their offences that required higher player involvement, using team work to screen for each other. The results show 19.5% usage of On the ball screens and 11.8% usage of Out the ball screens. This was statistically significantly higher than the BBL's 7.5% for On Ball Screens and 5.4% from Out of ball screens. When comparing these results to the original study which was taken from analysing the quarter finals of the 2008 Olympic Games (eight national teams), there is large difference between the average SCD classes used of all the nations compared to the domestic leagues. In particular space created off the dribble which is identified as 14.9% which is considerably lower than the BBL's 31.6%. Space created without the ball is a low 11.8% compared to this study which identified 33% and 37.6% for the ACB and BBL. More possession must have been used with On the ball screens which were 34.8% for the competition opposed to the lower scores of 19.5 for the ACB and 7.5 for the BBL.

A surprising result from this study was the non-significant finding of any difference between zone locations usage of the significantly different SCD classes. All three (Space create ball dribbled, On the ball screen and Out of ball screen) SCD classes showed no statistical difference in the zones which they

distributed between for their defensive ruptures. This carries a significant importance for the implications of this study. It shows that, although the distribution of the possession usage of the SCD classes is different. The zones which the BBL currently performs the SCD classes are statistically similar to the Liga ACB. The rate at which the SCD classes are being performed would need modification to replicate the Spanish Leagues tactical model; but the zones of the court which they are currently designating these SCD classes are at the same usage.

The results show that a large portion of the BBLs possessions are made up of space created off the dribble. This is 13.1% higher than the Liga ACB. There are many potential reasons for why this may be occurring. Firstly this could be caused via an over reliance on the imported players to create scoring opportunities without having to have large offensive flexibility in the types of attack used. With the dependence on British teams using imported players who come from more sophisticated basketball programs, it has been suggested that the imported players are given the ball and required to create their own space for a shot (Neter, 2011). This is in concurrence with literature which reported that during the last five minutes the game seems too focused on one player, with possible consequences of decreasing the game pace and increasing predictability (Ortega, Cardenas, Sainzde-Baranda, & Palao, 2006). Although this literature is not discussing the state of British Basketball it is applicable to how some of the British teams, over use their imported players.

Secondly, previous studies have found that in men's basketball there is an increased probability of obtaining a successful ball possession with only one pass or no passes at all during the first five minutes of the games. This may show that both teams are trying to be acquainted with the opponents'

weakness, and they use one-on-one situations and fast-breaks with only one pass more frequently, allowing them to receive a foul or score a basket (Fotinakis, Karipidis, & Taxildaris, 2002). Suggesting that the players in the BBL attempt to find the weaknesses in the oppositions defence, and more often a weakness is the inability to defend in one on one situations. Or that the BBL players are unable to identify any weaknesses and therefore spend the entire game trying to beat the opponents with one on one play. This also raises the secondary issue that the BBLs defensive rotation maybe unable to correctly play help defence in a man to man defensive system. Although if this were the case then there would expect to be a increase in the total number of possessions which end in perimeter isolation.

Thirdly, research has found men's teams increased possession effectiveness by using no passes from the durations between 0 and 20 seconds during the last five minutes. Sampaio, Lago, and Drinkwater (2010) stated that at the end of the game the strategic decisions are more conservative, because teams feel the importance of those moments and choose the less risky options. With players having a lack of general skills, such as passing, decision making and perception, the risk of causing a turnover by attempting a pass which could be intercepted is deemed a higher risk. Instead a one on one scenario forces a player to only focus on a sole defender and if they can gain space to create a shot or drive they have the potential to get fouled. It is considered to be a better strategy as at least it results in a shot opportunity and an offensive rebound could lead to another possession opposed to a turnover resulting in a fast-break for the opposition.

Finally, a potential reason to why there is a high usage of space created off the dribble is due to the breakdown of the offence set play. With the half

court set relying on all player working together to create a rupture in the defence, it needs all players to present a cohesive unit. In the BBL it is possible that the players are unable to complete the offensive sets which the coaching staff has designed. Resulting in a player being left with no choice but to attempt to create space off the dribble and create a shooting opportunity. This could be due to the lack of experience and knowledge of the coaching staff in the BBL (Neter, 2012). The coaching pathways provided for the BBL are insufficient for the level of coaching they are expected to achieve. A level 2 qualified coach, is theoretically on paper good enough to provide teaching to some of the best talent, but in reality it is develops coaches which are far from being an expert who should not be allowed such a prestigious responsibility (Neter, 2012). With the coaches being unable to design a set play which would be able to create a sufficient rupture in the defense for a scoring opportunity; it becomes a necessity for player to attempt to create space off the dribble.

The current study indicates that the Liga ACB uses On the ball screens 12% more than the BBL. It also indicated that the Liga ACB used 6.4% more Out of ball screens than the BBL. Authors have suggested the importance of group tactical offensive, such as screens on and off the ball and multiple screens to winning games (Gomez, Lorenzo, Ibanez, Ortega, Leite, & Sampaio, 2010). It has been speculated that the reasons for the high recurrence of On the ball screens and Out of ball screens is that it allows players which are athletic and accurate shooters to take advantage of the short time window provided by this SCD class (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011).

On the ball screen requires at least two players to work cohesively in order to carry out this SCD class. This requirement could be the reason that the Liga ACB uses this offence more frequently. The Spanish League is expected

to possess players which have more flexibility in their SCD classes. Having more players which are able to work together in SCD class could be a reason why there is an increase in SCD which have requires two player involvements. In previous studies it was found that in men's basketball there was a correlation between successful possessions and possessions which lasted longer than 16 seconds during the middle thirty minutes of a game (Gomez, Lorenzo, Ibanez, & Sampaio, 2013). These possession durations suggest that teamwork plays an important role in basketball (Mavridis, Laios, Taxildaris, & Tsiskar, 2003), in particular the collective tactical decisions that enable the creation of optimal space-time field goal opportunities (Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008).

With two players being involved in the On the ball screen it is a reasonable assumption that coaches would favour this SCD class if they had players with the ability to execute them correctly. The potential scoring situations from On the ball screen is larger than other SCD due to two players being involved with opportunities for both to score. After the screen occurs, the ball handler player may be free to score or the screener may receive a pass from the ball player in a better situation (Remmert, 2003). Players which have an affinity to the On the ball screen are useful to a basketball coach, as it provides many options of offences which can be implemented. The most heavily used are types of On the ball screen are; "pick and roll", "pick and pop", "drive and dish", "roll and dish" and "the slip" (Lindsey, 2012). These are all common types of use of the on the ball screen, this SCD gives the team multiple options which they can perform with the on the ball screen; which SCD classes which only use one on one situations do not. The aim of the defence is to attempt to be efficient in greatly reducing the space and the time window for the offensive

team to create scoring opportunities in modern basketball (Angel, Evangelos, & Alberto, 2006). With the defence needing to account for all these options of the on the ball screen it leads them to either defend the man or defend the space, leading to a rupture in the defensive system which on the ball screen has large potential to take advantage of.

This could potentially be the reason why the Liga ACB uses the on the ball screen more than the BBL. Players in the Liga ACB are considered to be superior in basketball in many ways, such as skill, physical ability and the decision making process; all of these attributes are used within on the ball screen SCD. The skills required are vast and vary depending on either the ball handler or the screener position. Essentially the core skills are driving, shooting, screening and cutting; the need to be able to execute all of these skills is crucial for the offensive players to ensure that all potential options for creating the scoring opportunity are available to them. Athleticism is required to perform the On the ball screen. The requirement is due to the need to perform it at its maximum efficiency with players requiring the combination of speed and strength to be able to create the space needed to take a shot. Although the physical attributes have yet to be compared between players in the leagues, with the players in the Liga ACB being able to dedicate themselves fully to basketball as a profession it would be reasonable hypothesis to assume they have an increase in both speed and strength on average to the players of the BBL. Players in the Liga ACB have the ability to process the options which they are presented to the by the defence within a very short time frame. Decision making is a key skill in On the ball screen SCD class as it revolves around the ball handler making the correct choice either to attempt to score or to pass to the screener for them to score.

Out of ball screen is the most complex out of all of the SCD classes as it requires the use of the most players. The ball handler player performs a pass to a teammate who receives a screen away from the ball, requiring the cohesive co-ordination of three players (Passer, Screener and Receiver). These actions involve teammates' co-ordination in great extensions of the court, as the screen may occur far from the ball player and be performed in several directions (i.e. vertical, horizontal, diagonal). Therefore, the number of players involved and the differences in decisional options for all the players involved on each of these classes are decisive aspects to classify this offensive class (Lamas, Rose, Santana, Rostaiser, & Negretti, 2011). Out of ball screen has also been found to occur more frequently in the Spanish national side than in other countries suggesting that as a nation they are trained for a higher diversity of behaviours after the screen is set which is compatible to Spain's multiple solution game strategy.

The Out of ball screen SCD class is vital to most coaches offensive sets in any basketball game, but executing it correctly to ensure a defensive rupture is key to making the offensive set successful. Of the research which has been carried out, there has been no correlation between men's basketball success and the use of out of ball screens. Yet studies into woman's basketball found that using off the ball screens was actually more effective than the more commonly used on the ball screens (Gomez, Ortega, Lorenzo, Ibanez, & Sampaio, 2009). The teams play with a slower game pace and are probably more focused on steals and offensive rebounds to initiate ball possessions. This would be something for the BBL to potentially extrapolate from this study. Slowing the pace at which the BBL is played at and using more off the ball screens similar to both the Liga ACB and the woman national basketball

association (WNBA) could generate more scoring opportunities with fewer turnovers. Although players would have to refocus the skill set which they would be required to use with more emphasis being placed upon shooting success with off the ball screens. This in concurrence with studies which have enforced the importance of shot selection within the defensive system. With the emphasis being placed upon screens, where team-work and good shooters play a special role in the winning teams (Mavridis, Laios, Taxildaris, & Tsiskar, 2003).

Out of ball screen is the only SCD which requires a pass to be made. The use of more passes and more time in the ball possessions reflects more assistances as well as good inside shots near the basket. In this way the winners spend less time dribbling and pass more frequently versus different defensive systems like zone half court, where the teams try to use spaces between players getting good shots without defensive pressure near the basket (Silva, 1998). This could allude to the reason that the Liga ACB uses more Out of ball screens due to the players having a higher ability to be able to execute accurate passes. BBL coaches need to train players in using Out of ball screens and the ball handlers to ensure that they know when to pass the ball to the player to correlate most with success.

The development of the BBL will be dependent on the coach's ability to recognise where changes need to be made and why. Performance analysis studies such as the current study should be utilised by coaches for the development of both players and the progress of the league. The current study aligns with previous literature about the tactical use of offense in basketball. Literature has researched the use of four players and durations ranging from 0 to 20 seconds in allowing the exploration of collective team plays in order to create space and time near to the basket (Mavridis, Laios, Taxildaris, & Tsiskar,

2003). However, when only one pass was used, the probability of obtaining successful ball possessions was reduced. The teams had lower success when they did not use screens and attacked against zone defences (Gomez, Lorenzo, Ibanez, & Sampaio, 2013). These results support the idea that screening is associated with more points per possession (Remmert, 2003) as they allow the provision of extra space and time to play by relieving the defensive pressure.

The practical implications of this study should be primarily aimed at the coaches and then secondly aimed at the players. One of the most important tasks for basketball coaches is to prepare practice sessions according to competition constraints (Sampaio, Lago, & Drinkwater, 2010). Currently the constraints of the BBL are being coached for, but this is one of the limitations which are holding the BBL from improving its standard of play. If the coaches were to coach to the constraints of the competition placed in the Liga ACB this has the potential to dramatically improve the standard of tactical play in the BBL. Players' interactions are constantly present in the games and may influence the different tactical approaches to score or prevent the opponents from scoring (Remmert, 2003). Currently the interactions of the players means that coaches design set offences based around the premise that the players perform more successfully in one on one situations. This may be the case for the overall per possession statistics but it is preventing the development of the League into becoming a larger power in basketball. Developing the team to use multiple solutions to create a rupture in the defence would lead to a more developed league which could mimic the tactical play of the elite Liga ACB.

The SCD classes may be considered as a generic profile to explain the different game strategies implemented by teams but as an overview of teams it could be useful for coaches to start tracking both the rate at which their

own team performs these SCD classes as well as opponents. Developing coaches with the knowledge of how multiple solutions should be used in basketball will be key to ensuring that basketball grows in Britain. Providing a platform for elite players to be able to develop their skills and compete at a high level to attempt to match those of European Leagues, will mean that more home grown talent will come forth as well as being able to attract elite players from other countries.

The practical applications for performance analysts from this study could potentially be very useful to the field. Deriving statistics for the British Basketball League to encourage players to mimic the Spanish style of play which could be used within the box score could have large implications. Tracking the use of On the ball and Out of ball screens to create ruptures in the defence, to give scoring opportunities would enable both players and coaches a representation at how specific players interact with their team mates. It would require a comprehensive model in which there was a difference for screens which led to a scoring opportunity which was successful or unsuccessful. This could then be normalised per possession which the player was on court similar to per minute statistics (Kubatko, Oliver, Pelton, & Rosenbaum, 2007). An example of this could be:

$$Screens40_p = Screens_p / Min_p \times 40,$$

where $Screens_p$ is screens made by player p and Min_p is minutes for player p . This potential example would be for overall scoring opportunities from screens created, but this could be manipulated if the coach wanted to solely seek out successful scoring opportunities from screening. Alternatively using the

rebounding rate model (Eldridge, 2010) which could be used to incorporate the opportunities which the player had to screen:

$$Screen\%_p = (Screens_p / OffPoss_t) / (Min_p / Min_t)$$

where *Screen_p* is Screens made by player *p*, *OffPoss_t* is offensive possessions had by team, and , *Min_p* is minutes for player *p*, and *Min_t* is minutes for team *t*. Both would give coaches a good representative model for the frequency and success rate at which players set screens to cause a rupture in the defence to create scoring opportunities. This type of statistical development would assist the coach in showing players the rate at which they set the type of screens required to match the Spanish style of play. As well as allowing coaches too thoroughly scout players which they wish to bring into the club for the purpose of creating defensive ruptures through good team work and screening.

Despite the benefits of this study there were limitations which prevented it from having an increased impact upon the British Basketballs Leagues future. The sample size of this study was relatively small, with twelve games from each league being analysed. Analysing more games over a course of multiple seasons would allow for a more accurate profile of the leagues SCD being created. The researcher has to select a number of matches to represent each subject that will ensure that all of the performance indicators to be used will stabilise (O'Donoghue, 2005). There are many different factors that can cause within-subject variation in performance, such as venue (Devlin, Brennan, & O'Donoghue, 2004), the importance of the match (Hale, 2004) and the tactics adopted (Reilly, 2003). Performing a profile on multiple teams to represent a

league would require a large number of games to be analysed for the model to stabilise.

The Lamas, Rose, Santana, Rostaiser and Negretti (2011) model for SCD classes has a large omission when placed into a tactical evaluative model. The most commonly used SCD was space created without the ball with the British Basketball League using it 37.57% and the Spanish Liga ACB using it 33.02%. Space created without the ball can refer to a vast range of movements on an individual level i.e. back door cuts and UCLA cuts. Retrospectively this should have been split into two more classes, an individual movement class and a drive and kick class. The drive and kick strategy was not explored in the original paper, it requires a player to dribble towards the basket, and when the defence collapses, the player passes the ball out to a player for a spot up shot. In this model this appears as space created without the ball, as the player has found themselves in space but actually the rupture in the defence comes from the player dribbling towards the basket.

The purpose of the SCD was that they provide a more detailed version of the play by play log and deliver the context in which the performance indicators are generated. Although they do provide greater detail for coaches to how scoring opportunities are generated they still require more context to how they were generated to be seen as the last stage in their development. This is in reference to the defensive situation that the SCD were executed. Whether this was man to man defence or a zonal defence makes a large difference to which SCD class should be used tactically. Therefore despite the present results that are characterising the highest level of basketball tactics, extrapolation of all the data should be consider difference in defensive sets faced.

Future research should focus on validating the different SCD classes within different defensive contexts to give a more comprehensive understanding of team strategy and tactics. This future research would allow coaches to be able to gain a better understanding of which tactics of SCD they should be focusing on for each defensive set. Whether in a man to man defence will make a large difference to the tactical demands of the competition, with most teams using various defensive sets throughout a match coaches will need to have knowledge of multiple required tactical options. Man to man defence may allow for more screening to be used compared to zone defence which requires more movement off the ball with players creating space without the ball for spot up shots moving the ball around the defence. This should be done alongside the other limitations of this study by expanding the space created without the ball and a larger sample size. Preliminary testing should also be carried out on whether the “Hockey assist” is worth researching within SCD or whether it is requires its own separate statistical research.

Conclusion

The use of SCD classifications has proven the ability to create a generic profile for game strategies and tactics in elite basketball. Their descriptive qualities assist both coaches and performance analysts in clearly explaining the events of a match. This method of developing a more comprehensive description than the play by play log book gives coaches numerous advantages. The application of SCD into the current study brought about interesting findings. The hypothesis that the Spanish Elite league uses more SCD which has greater player involvement was proven correct. Whilst also finding that the British Basketball League uses SCD which are based around one on one scenarios. The current study showed that although there were differences between strategies, tactics and frequency distributions of SCD the area in which they were used in were not different. The current study found there to be no statistical difference between the zone locations at which the different SCD took place.

This study has implications for the BBL, British Coaches, the British coaching pathways (England Basketball and UKCC) and basketball performance analysts. The largest implication is on the BBL and the British Coaches of the teams within the BBL. The half court offensive set makes up 67.07% of the BBLs possessions. The importance of offensive flexibility has been shown within using the Elite Spanish Liga ACB who distribute their offensive sets with a higher emphasis on SCDs which have higher player involvement compared to the British League. Coaches of the BBL should gather from this study the importance of developing more offensive sets which utilise more on the ball screens and out of ball screens. Developing these offensive sets will ensure that tactically and strategically the BBL is able to develop an offensive arsenal which is replicable to the elite league. Coaches would need to

re-evaluate the training methods which they are currently using, as the emphasis is currently on ensuring that players are individually able to create a rupture in the defence, when the emphasis should be placed on team work to create opportunities for team mates.

For this to then be sustainable for the future this message should filter throughout the coaching training pathway systems which are in place. The pathways should focus on providing new coaches the knowledge that is required to develop the British youth into becoming well rounded players who are capable of performing the correct SCDs. Coaching the key skill which are required to make the accurate screen and the motion pathways which they should follow after the screen to create a scoring opportunity. Performance analysts can assist the coaches in the development of players. By providing empirical evidence to the coaches and players into the benefits of screening for team mates this would educate them on the advantages. The use of a screening statistic which would give both the players and coaches a visual statistic which they would be able to track from game to game would greatly assist in this. This would be an asset to coaches in both terms of the progressing players which they already have on the team but also for scouting new players to bring in. Future studies should focus on the use of SCD within different defensive strategies as this will greatly impact the SCD classes used.

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Appendix A –Ethical Approval



***Faculty of Applied Sciences
Research Ethics Committee***

frec@chester.ac.uk

Phillip Crum

20th August 2013

Dear Phillip,

Study title: **Space Creation Dynamics in Basketball: A comparison
between British and Spanish Domestic Leagues.**

FREC reference: **850/13/PC/SES**

Version number: **1**

Thank you for sending your application to the Faculty of Applied Sciences Research Ethics Committee for review.

I am pleased to confirm ethical approval for the above research, provided that you comply with the conditions set out in the attached document, and adhere to the processes described in your application form and supporting documentation.

The final list of documents reviewed and approved by the Committee is as follows:

Document	Version	Date
Application Form	1	August 2013
Response to FREC request for further information (FREC Application 839/13/PC/SES reviewed 17/07/2013)		August 2013
Appendix 1 – List of References	1	August 2013
Appendix 2 – C.V. for Lead Researcher	1	August 2013

Appendix 3 – Written Permission, C. Dempsey, Head of Sport Science, Chester Jets	1	August 2013
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With the Committee's best wishes for the success of this project.

Yours sincerely,




Dr. Stephen Fallows

Chair, Faculty Research Ethics Committee

Enclosures: Standard conditions of approval.

Cc. Supervisor/FREC Representative

Appendix B – Domestic League Ranking

Rank ◆	National Domestic League ◆
1.	 Spanish ACB
2.	VTB United League   (Formerly Soviet Union League) 
3.	 Russian PBL
4.	 Greek GBL
5.	 Italian Lega A
6.	 Turkish TBL
7.	 French Pro A
8.	 German BBL
9.	 Lithuanian LKL
10.	Adriatic League  (Formerly Yugoslav YUBA Liga) 
11.	 Polish PLK
12.	 Belgian BLB
13.	 Czech NBL
14.	 Ukrainian SuperLeague
15.	 Israeli Super League
16.	 Bulgarian NBL
17.	 Dutch DBL
18.	 Latvian LBL

Appendix C – Visual Representation of SCD taken from Lamas, Rose, Santana, Rostaiser, and Negretti (2011)

Appendix D Intra and Inter Rater Reliability

Intra- and inter-rater reliability was performed using the Cooper et al (2007) method. The SCD techniques were analysed using sixteen time cells of two minutes thirty seconds each. The intra- and inter-rater reliability testing shows there was no systematic bias for the testing with all indicators being greater than $P = >0.05$ for any of the seven indicators. The Cooper et al. (2007) intra and inter reliability test shows that five of the seven performance indicators had 100% proportions of agreement at ± 0 . The intra reliability test produced two discrepancies, which were from SC Ball Dribbled ($P=1(0.5)$, $PA=93.75\%$, $CI\ 81-100\%$) and SC without Ball ($P=1(0.5)$, $PA=93.75\%$, $CI\ 81-100\%$). The Inter-rater reliability also showed discrepancies with SC Ball Dribbled ($P=1(0.688)$, $PA=75\%$, $CI\ 54-96\%$) and SC without ball ($P=1(0.5)$, $PA=93.75\%$, $CI\ 81-100\%$). Yet as the reference value was set at ± 1 the confidence interval for all performance indicators is 100% meeting the gold standard criteria.

Performance indicator	Median (sign test P)	Percentiles		PA = 0 (%)	Confidence interval (%)	PA ± 1 (%)	Confidence interval (%)
		2.50 %	97.50 %				
SC Ball Dribbled	1 (0.5)	2.625	0.625	93.75	81-100	100	100
SC Ball not Dribbled	1 (1)	0	0	100	100	100	100
SC Without Ball	1 (0.5)	2.625	0.625	93.75	81-100	100	100
On Ball Screen	1 (1)	0	0	100	100	100	100
Out of Ball Screen	1 (1)	0	0	100	100	100	100
Post Isolation	1 (1)	0	0	100	100	100	100
Perimeter Isolation	1 (1)	0	0	100	100	100	100

Intra Rater Reliability

Performance indicator	Median (sign test P)	Percentiles		PA = 0 (%)	Confidence interval (%)	PA ± 1 (%)	Confidence interval (%)
		2.50%	97.50%				
SC Ball Dribbled	1 (0.688)	1	0.625	75	54-96	100	100
SC Ball not Dribbled	1 (1)	0	0	100	100	100	100
SC Without Ball	1 (0.5)	0	0.625	93.75	82-100	100	100
On Ball Screen	1 (1)	0	0	100	100	100	100
Out of Ball Screen	1 (1)	0	0	100	100	100	100
Post Isolation	1 (1)	0	0	100	100	100	100
Perimeter Isolation	1 (1)	0	0	100	100	100	100

Inter Rater Reliability

Complying with the Cooper et al (2007) methodology to ensure that the majority of time cells having a frequency count within them, the zones were grouped into outer range (1,2 and 3), mid range (4,5 and 6), close range (7 and 9) and under the basket (8). Under the basket was analysed using the same time cells as the SCD techniques of sixteen time cells of two minutes thirty seconds each. Outer, mid and close range were analysed using eight time cells of five minutes each to ensure that there was a frequency count in the majority of the time cells. The intra- and inter-rater reliability testing shows there was no systematic bias for the testing with all indicators being greater than $P = >0.05$ for any of the twenty eight performance indicators and zones. The Cooper et al. (2007) intra reliability and inter reliability test shows that twenty five of the twenty eight performance indicators had 100% proportions of agreement at ± 0 . The intra reliability test produced three discrepancies, which were from SC Ball Dribbled outer range(1,2 and 3) ($P=1(0.5)$, $PA=87.5\%$, CI 64-100%), SC Ball Dribbled under basket (8) ($P=1(0.75)$, $PA=87.5\%$, CI 71-100%), and SC without Ball under basket (8) ($P=1(0.75)$, $PA=87.5\%$, CI 71-100%). The inter reliability test produced three discrepancies, which were from SC Ball Dribbled outer range(1,2 and 3) ($P=1(0.5)$, $PA=87.5\%$, CI 64-100%), SC Ball Dribbled under basket (8) ($P=1(0.688)$, $PA=75\%$, CI 54-96%), and SC without Ball under basket (8) ($P=1(0.75)$, $PA=87.5\%$, CI 71-100%).

Performance indicator	Zone	Median (sign test P)	Percentiles		PA = 0 (%)	Confidence interval (%)	PA ± 1 (%)	Confidence interval (%)
			2.50 %	97.50 %				
SC Ball Dribbled	1,2,3	1(0.5)	0.825	0	87.5	64-100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (0.75)	0.625	0.625	87.5	71-100	100	100
SC Ball not Dribbled	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
SC Without Ball	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (0.75)	0.625	0.625	87.5	71-100	100	100
On Ball Screen	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
Out of Ball	1,2,3	1 (1)	0	0	100	100	100	100

Screen	3							
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
Post Isolation	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
Perimeter Isolation	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
Intra-rater Reliability								
Percentiles								
Performance indicator	Zone	Median (sign test P)			PA = 0 (%)	Confidence interval (%)	PA \pm 1 (%)	Confidence interval (%)
			2.50 %	97.50 %				
SC Ball Dribbled	1,2,3	1(0.5)	0.825	0	87.5	64-100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (0.688)	1	0.625	75	54-96	100	100
SC Ball not Dribbled	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
SC Without Ball	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (0.75)	0.625	0.625	87.5	71-100	100	100
On Ball Screen	1,2,3	1 (1)	0	0	100	100	100	100
	4,5,6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
Out of Ball	1,2,3	1 (1)	0	0	100	100	100	100

Screen	3							
	4,5.							
	6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100
Post Isolation	1,2,							
	3	1 (1)	0	0	100	100	100	100
	4,5.							
	6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
Perimeter Isolation	8	1 (1)	0	0	100	100	100	100
	1,2,							
	3	1 (1)	0	0	100	100	100	100
	4,5.							
	6	1 (1)	0	0	100	100	100	100
	7,9	1 (1)	0	0	100	100	100	100
	8	1 (1)	0	0	100	100	100	100

Appendix ESPSS Data

Descriptives				
	League		Statistic	Std. Error
SC Ball Dribbled	BBL	Mean	31.5992	1.82447
		95% Confidence Interval for Mean	Lower Bound	27.5835
			Upper Bound	35.6148
		5% Trimmed Mean	31.5346	
		Median	29.9800	
		Variance	39.944	
		Std. Deviation	6.32014	
		Minimum	23.33	
		Maximum	41.03	
		Range	17.70	
		Interquartile Range	11.84	
		Skewness	.252	.637
		Kurtosis	-1.344	1.232
	ACB	Mean	18.5158	1.54175
		95% Confidence Interval for Mean	Lower Bound	15.1225
			Upper Bound	21.9092
		5% Trimmed Mean	18.7170	
		Median	20.4900	
		Variance	28.524	
		Std. Deviation	5.34077	
		Minimum	9.65	
		Maximum	23.76	
		Range	14.11	
		Interquartile Range	10.75	
		Skewness	-.600	.637
		Kurtosis	-1.334	1.232
SC Ball not Dribbled	BBL	Mean	2.2900	.41951
		95% Confidence Interval for Mean	Lower Bound	1.3667
			Upper Bound	3.2133
		5% Trimmed Mean	2.2978	
		Median	2.5650	
		Variance	2.112	
		Std. Deviation	1.45323	
		Minimum	.00	
		Maximum	4.44	
		Range	4.44	

SC Without Ball	ACB	Interquartile Range		2.18		
		Skewness		-.314	.637	
		Kurtosis		-.759	1.232	
		Mean		2.2350	.26183	
		95% Confidence Interval for	Lower Bound	1.6587		
		Mean	Upper Bound	2.8113		
		5% Trimmed Mean		2.2106		
		Median		2.3550		
		Variance		.823		
		Std. Deviation		.90700		
		Minimum		.99		
		Maximum		3.92		
		Range		2.93		
		Interquartile Range		1.43		
		Skewness		.049	.637	
	BBL	Kurtosis		-.344	1.232	
		Mean		37.5733	1.03795	
		95% Confidence Interval for	Lower Bound	35.2888		
		Mean	Upper Bound	39.8579		
		5% Trimmed Mean		37.6059		
		Median		38.0300		
		Variance		12.928		
		Std. Deviation		3.59558		
		Minimum		31.82		
		Maximum		42.74		
		Range		10.92		
		Interquartile Range		5.78		
		Skewness		-.174	.637	
		ACB	Kurtosis		-.702	1.232
			Mean		33.0142	1.41475
95% Confidence Interval for	Lower Bound		29.9003			
Mean	Upper Bound		36.1280			
5% Trimmed Mean			33.2652			
Median			33.5000			
Variance			24.018			
Std. Deviation			4.90084			
Minimum			22.77			
Maximum			38.74			
Range			15.97			
Interquartile Range			7.56			
Skewness			-.768	.637		
On Ball Screen	BBL		Kurtosis		.066	1.232
			Mean		7.4958	.71498
		95% Confidence Interval for	Lower Bound	5.9222		
		Mean	Upper Bound	9.0695		

Out of Ball Screen	ACB	5% Trimmed Mean	7.4476	
		Median	7.5500	
		Variance	6.134	
		Std. Deviation	2.47678	
		Minimum	3.13	
		Maximum	12.73	
		Range	9.60	
		Interquartile Range	1.82	
		Skewness	.327	.637
		Kurtosis	1.315	1.232
		Mean	19.4908	2.21475
		95% Confidence Interval for Mean	Lower Bound	14.6162
			Upper Bound	24.3655
		5% Trimmed Mean	19.3481	
	BBL	Median	19.4050	
		Variance	58.861	
		Std. Deviation	7.67212	
		Minimum	6.86	
		Maximum	34.69	
		Range	27.83	
		Interquartile Range	6.07	
		Skewness	.040	.637
		Kurtosis	.857	1.232
		Mean	5.3592	.94630
		95% Confidence Interval for Mean	Lower Bound	3.2764
			Upper Bound	7.4420
		5% Trimmed Mean	5.2030	
		Median	5.4600	
	ACB	Variance	10.746	
		Std. Deviation	3.27809	
		Minimum	1.71	
		Maximum	11.82	
		Range	10.11	
		Interquartile Range	4.74	
		Skewness	.613	.637
		Kurtosis	-.290	1.232
		Mean	11.7917	1.10367
		95% Confidence Interval for Mean	Lower Bound	9.3625
			Upper Bound	14.2208
		5% Trimmed Mean	11.7963	
		Median	12.6050	
		Variance	14.617	
		Std. Deviation	3.82324	
		Minimum	5.32	
		Maximum	18.18	

Post Isolation	BBL	Range	12.86	
		Interquartile Range	4.33	
		Skewness	.165	.637
		Kurtosis	-.343	1.232
		Mean	12.3950	1.02970
		95% Confidence Interval for Mean	Lower Bound	10.1287
			Upper Bound	14.6613
		5% Trimmed Mean	12.2811	
		Median	12.4400	
		Variance	12.723	
		Std. Deviation	3.56698	
		Minimum	6.84	
		Maximum	20.00	
		Range	13.16	
		Interquartile Range	3.42	
	ACB	Skewness	.597	.637
		Kurtosis	.980	1.232
		Mean	11.6850	1.04239
		95% Confidence Interval for Mean	Lower Bound	9.3907
			Upper Bound	13.9793
		5% Trimmed Mean	11.7172	
		Median	12.0100	
		Variance	13.039	
		Std. Deviation	3.61093	
		Minimum	5.98	
		Maximum	16.81	
		Range	10.83	
		Interquartile Range	5.65	
Perimeter Isolation	BBL	Skewness	-.298	.637
		Kurtosis	-1.046	1.232
		Mean	3.2708	.55919
		95% Confidence Interval for Mean	Lower Bound	2.0401
			Upper Bound	4.5016
		5% Trimmed Mean	3.1109	
		Median	2.2050	
		Variance	3.752	
		Std. Deviation	1.93710	
		Minimum	1.64	
		Maximum	7.78	
		Range	6.14	
		Interquartile Range	2.89	
		Skewness	1.210	.637

	Kurtosis	1.076	1.232
	Mean	3.2642	.61676
	95% Confidence Interval for Mean	Lower Bound 1.9067	
		Upper Bound 4.6216	
	5% Trimmed Mean	3.1869	
	Median	2.9400	
	Variance	4.565	
ACB	Std. Deviation	2.13652	
	Minimum	.85	
	Maximum	7.07	
	Range	6.22	
	Interquartile Range	3.86	
	Skewness	.567	.637
	Kurtosis	-.906	1.232

Tests of Normality							
	League	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
SC Ball Dribbled	BBL	.163	12	.200 [*]	.922	12	.305
	ACB	.203	12	.183	.856	12	.043
SC Ball not Dribbled	BBL	.137	12	.200 [*]	.951	12	.651
	ACB	.160	12	.200 [*]	.929	12	.371
SC Without Ball	BBL	.159	12	.200 [*]	.940	12	.502
	ACB	.157	12	.200 [*]	.933	12	.412
On Ball Screen	BBL	.191	12	.200 [*]	.947	12	.589
	ACB	.174	12	.200 [*]	.931	12	.388
Out of Ball Screen	BBL	.172	12	.200 [*]	.905	12	.182
	ACB	.183	12	.200 [*]	.947	12	.587
Post Isolation	BBL	.187	12	.200 [*]	.950	12	.630
	ACB	.155	12	.200 [*]	.943	12	.544
Perimeter Isolation	BBL	.270	12	.016	.800	12	.009
	ACB	.181	12	.200 [*]	.913	12	.230

*. This is a lower bound of the true significance.

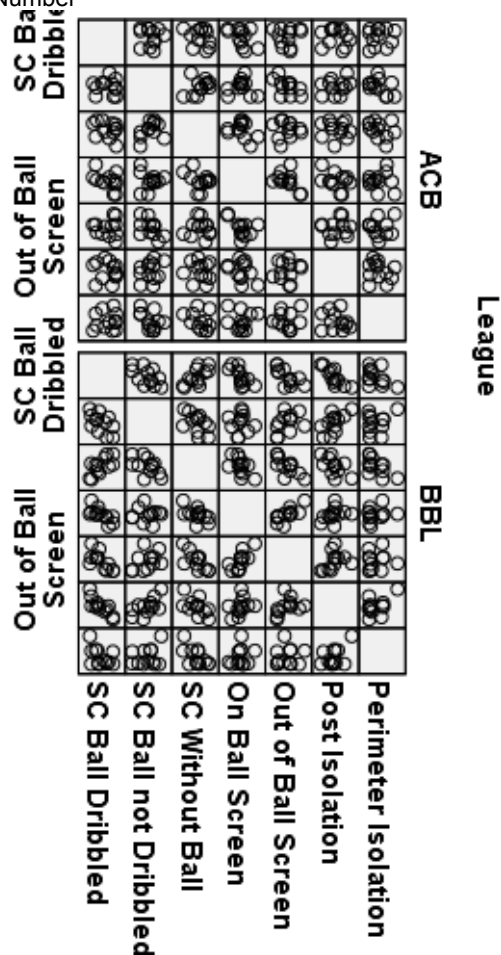
a. Lilliefors Significance Correction

Multivariate Normality

Residuals Statistics ^a					
	Minimum	Maximum	Mean	Std. Deviation	N

Predicted Value	2.68	9.19	6.50	1.624	24
Std. Predicted Value	-2.352	1.657	.000	1.000	24
Standard Error of Predicted Value	1.146	2.666	1.912	.468	24
Adjusted Predicted Value	.75	12.55	6.48	2.561	24
Residual	-5.801	5.090	.000	3.130	24
Std. Residual	-1.593	1.398	.000	.860	24
Stud. Residual	-1.944	1.535	.002	1.023	24
Deleted Residual	-8.640	6.138	.021	4.512	24
Stud. Deleted Residual	-2.139	1.605	-.007	1.050	24
Mahal. Distance	1.319	11.377	5.750	3.144	24
Cook's Distance	.000	.264	.067	.069	24
Centered Leverage Value	.057	.495	.250	.137	24

a. Dependent Variable: Game Number



Correlations		SC Ball Dribbled	SC Ball not Dribbled	SC Without Ball	On Ball Screen	Out of Ball Screen	Post Isolation	Perimeter Isolation
SC Ball Dribbled	Pearson Correlation	1	-.231	.452*	-.767**	-.680**	-.244	-.123
	Sig. (2-tailed)		.278	.027	.000	.000	.251	.567

	N	24	24	24	24	24	24	24
SC Ball not	Pearson							
	Correlation	-.231	1	-.084	-.040	-.009	.481 [*]	-.024
Dribbled	Sig. (2-tailed)	.278		.697	.851	.966	.017	.910
	N	24	24	24	24	24	24	24
SC Without Ball	Pearson	.452 [*]	-.084	1	-.569 ^{**}	-.519 ^{**}	-.201	-.388
	Correlation							
	Sig. (2-tailed)	.027	.697		.004	.009	.347	.061
	N	24	24	24	24	24	24	24
On Ball Screen	Pearson	-.767 ^{**}	-.040	-.569 ^{**}	1	.398	-.199	.023
	Correlation							
	Sig. (2-tailed)	.000	.851	.004		.054	.352	.914
	N	24	24	24	24	24	24	24
Out of Ball Screen	Pearson	-.680 ^{**}	-.009	-.519 ^{**}	.398	1	.083	.061
	Correlation							
	Sig. (2-tailed)	.000	.966	.009	.054		.701	.777
	N	24	24	24	24	24	24	24
Post Isolation	Pearson	-.244	.481 [*]	-.201	-.199	.083	1	.138
	Correlation							
	Sig. (2-tailed)	.251	.017	.347	.352	.701		.520
	N	24	24	24	24	24	24	24
Perimeter	Pearson	-.123	-.024	-.388	.023	.061	.138	1
	Correlation							
Isolation	Sig. (2-tailed)	.567	.910	.061	.914	.777	.520	
	N	24	24	24	24	24	24	24

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Multivariate Tests^a

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's Trace	1.000	12041260.39 0 ^b	7.000	16.000	.000	1.000
Wilks' Lambda	.000	12041260.39 0 ^b	7.000	16.000	.000	1.000
Hotelling's Trace	5268051.421	12041260.39 0 ^b	7.000	16.000	.000	1.000
Roy's Largest Root	5268051.421	12041260.39 0 ^b	7.000	16.000	.000	1.000
Pillai's Trace	.747	6.764 ^b	7.000	16.000	.001	.747
League Wilks' Lambda	.253	6.764 ^b	7.000	16.000	.001	.747
Hotelling's Trace	2.959	6.764 ^b	7.000	16.000	.001	.747

Roy's Largest Root	2.959	6.764 ^b	7.000	16.000	.001	.747
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a. Design: Intercept + League

b. Exact statistic

Tests of Between-Subjects Effects							
Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	SC Ball Dribbled	1027.042 ^a	1	1027.042	30.001	.000	.577
	SC Ball not Dribbled	.018 ^b	1	.018	.012	.912	.001
	SC Without Ball	124.716 ^c	1	124.716	6.751	.016	.235
	On Ball Screen	863.280 ^d	1	863.280	26.564	.000	.547
	Out of Ball Screen	248.262 ^e	1	248.262	19.577	.000	.471
	Post Isolation	3.025 ^f	1	3.025	.235	.633	.011
	Perimeter Isolation	.000 ^g	1	.000	.000	.994	.000
Intercept	SC Ball Dribbled	15069.079	1	15069.079	440.179	.000	.952
	SC Ball not Dribbled	122.854	1	122.854	83.730	.000	.792
	SC Without Ball	29895.571	1	29895.571	1618.323	.000	.987
	On Ball Screen	4369.681	1	4369.681	134.460	.000	.859
	Out of Ball Screen	1764.907	1	1764.907	139.172	.000	.863
	Post Isolation	3479.078	1	3479.078	270.092	.000	.925
	Perimeter Isolation	256.237	1	256.237	61.617	.000	.737
League	SC Ball Dribbled	1027.042	1	1027.042	30.001	.000	.577
	SC Ball not Dribbled	.018	1	.018	.012	.912	.001
	SC Without Ball	124.716	1	124.716	6.751	.016	.235
	On Ball Screen	863.280	1	863.280	26.564	.000	.547
	Out of Ball Screen	248.262	1	248.262	19.577	.000	.471
	Post Isolation	3.025	1	3.025	.235	.633	.011
	Perimeter Isolation	.000	1	.000	.000	.994	.000
Error	SC Ball Dribbled	753.148	22	34.234			
	SC Ball not Dribbled	32.280	22	1.467			
	SC Without Ball	406.410	22	18.473			
	On Ball Screen	714.954	22	32.498			
	Out of Ball Screen	278.993	22	12.682			
	Post Isolation	283.384	22	12.881			
	Perimeter Isolation	91.488	22	4.159			

Total	SC Ball Dribbled	16849.269	24
	SC Ball not Dribbled	155.152	24
	SC Without Ball	30426.697	24
	On Ball Screen	5947.915	24
	Out of Ball Screen	2292.162	24
	Post Isolation	3765.487	24
	Perimeter Isolation	347.726	24
	Corrected Total	1780.189	23
	SC Ball Dribbled	32.298	23
Corrected Total	SC Ball not Dribbled	531.126	23
	SC Without Ball	1578.234	23
	On Ball Screen	527.256	23
	Out of Ball Screen	286.408	23
	Post Isolation	91.488	23
	Perimeter Isolation		

- a. R Squared = .577 (Adjusted R Squared = .558)
b. R Squared = .001 (Adjusted R Squared = -.045)
c. R Squared = .235 (Adjusted R Squared = .200)
d. R Squared = .547 (Adjusted R Squared = .526)
e. R Squared = .471 (Adjusted R Squared = .447)
f. R Squared = .011 (Adjusted R Squared = -.034)
g. R Squared = .000 (Adjusted R Squared = -.045)

League					
Dependent Variable	League	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
SC Ball Dribbled	BBL	31.599	1.689	28.096	35.102
	ACB	18.516	1.689	15.013	22.019
SC Ball not Dribbled	BBL	2.290	.350	1.565	3.015
	ACB	2.235	.350	1.510	2.960
SC Without Ball	BBL	37.573	1.241	35.000	40.146
	ACB	33.014	1.241	30.441	35.587
On Ball Screen	BBL	7.496	1.646	4.083	10.909
	ACB	19.491	1.646	16.078	22.904
Out of Ball Screen	BBL	5.359	1.028	3.227	7.491
	ACB	11.792	1.028	9.660	13.924
Post Isolation	BBL	12.395	1.036	10.246	14.544
	ACB	11.685	1.036	9.536	13.834
Perimeter Isolation	BBL	3.271	.589	2.050	4.492

ACB	3.264	.589	2.043	4.485
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Appendix F- Raw Data